cc. Ken Howard

Incorporated

Suite 1235
Cherry Creek Plaza
600 South Cherry Street
Denver, Colorado 80222
(303) 321-5981

Mark -

Please circulate to Grunig and others in Anaconda who need to see this report. Thanks.

J. N. Brooke



August 31, 1976

Wyoming Mineral Corporation
3900 South Wadsworth Blvd.
Lakewood, CO 80235

ATTN: Mr. W. J. Reilly

Dear Sir:

We are enclosing two copies of our report entitled, "Yerington Uranium Plant, Preliminary Capital and Operating Costs." This report is in response to your Purchase Order No. D548-6903 and various discussions with Dr. J. Brooke during the performance of the work.

The report relates specifically to a preliminary estimate of the capital and operating costs of proposed facilities installed and operated at Yerington, Nevada. This processing plant would have sufficient capacity to produce approximately 50,000 pounds per year of $U_3O_8$ as yellowcake, from 700 gallons per minute of Yerington copper leach liquors.

Several alternates have been examined, primarily to determine if there are economic advantages in capital and/or operating costs, if partially-complete processing is carried out at Yerington, and the processing is finalized at the Bingham Canyon facilities.

We wish to express our appreciation for the opportunity to participate in this project, and we hope that our contribution will assist in your economic evaluation of the project.



3180L.01

6-18-76
1:55 p.m.

Tom Bright (303) [illegible]-9414

Told him samples from mine should be shipped tomorrow a.m.

Small upper pond averaged about 500 ppm.
Main pond averaged approximately 20 ppm.

[illegible]

Please advise us if we can provide further assistance, or if clarification is required on any points in this report.

Yours very truly,

Robert Olson

E. R. Olson
President

ERO/c

cc: Dr. James Brooke

# YERINGTON URANIUM PLANT
# PRELIMINARY CAPITAL AND OPERATING COSTS

A Report to:

WYOMING MINERAL CORPORATION

Prepared by:

KILBORN/NUS INC.
Denver, Colorado

August 31, 1976

# YERINGTON URANIUM PLANT
# PRELIMINARY CAPITAL AND OPERATING COSTS

Table of Contents

# YERINGTON URANIUM PLANT

# PRELIMINARY CAPITAL AND OPERATING COSTS

## 1. INTRODUCTION

By copy of Wyoming Mineral Corporation Purchase Order No. D548-6903 dated July 21, 1976, Kilborn/NUS Inc. was requested to develop a preliminary capital and operating cost estimate for a proposed uranium recovery plant to be located at Yerington, Nevada.

The scope of the assignment and services to be provided by Kilborn/NUS are outlined in a letter to Dr. James Brooke of Wyoming Mineral Corporation, dated July 14, 1976.

A meeting was held in the Wyoming Mineral offices on July 27 and was attended by Dr. Brooke of Wyoming Mineral, and Mr. E. R. Olson and Mr. L. S. Bates of Kilborn/NUS. At this meeting, the scope of the assignment and services to be provided by Kilborn/NUS were reviewed. Technical data to be used in flow sheet development was given to Kilborn/NUS at this meeting.

A visit to the Yerington site was made by Mr. Bates on July 29 to examine the proposed site and to collect information relative to interfacing of the proposed plant with the existing operation. Information concerning existing labor rates and costs of reagents was also obtained. Mr. Mark Nesbitt, General Manager, and Mr. Kent McGrew, Metallurgical Engineer, were the people contacted at the Yerington site.

This report primarily concerns a preliminary estimate of the capital expenditures required to install facilities for treatment of uranium-bearing copper leach liquors; and a preliminary estimate of the operating costs associated with these facilities.

The preliminary nature of the estimates must be emphasized, since their development was based on flow sheet information only.

The base case capital and operating costs were determined on the basis of complete facilities at the Yerington site. The base case costs were modified to reflect cost differences if partial processing facilities were installed and operated at Yerington, and final processing was carried out at the Bingham Canyon plant.

A description of the various alternatives examined and a summary of preliminary capital costs appear in Section 2 of this report. A summary of the preliminary operating costs is contained in Section 3. Capital and operating cost details appear in the Appendix of the report.

## 2. SUMMARY OF PRELIMINARY CAPITAL COSTS

The preliminary capital cost summary which follows was developed on the basis of standard flow sheet information only. General arrangement drawings were not developed since this estimate was to be of the factored type and for comparative purposes only. A preliminary layout drawing is included. It was drawn to establish the size of building required.

The base case capital cost estimate was developed on the basis of the flow sheet which is included in the Appendix of this report. Several alternates were examined to determine the effect on capital if only partially complete facilities were constructed at Yerington and if the processing would be completed elsewhere at existing or suitably modified facilities.

The base case and alternate approaches examined are as follows:

A. Base Case

This includes complete facilities to recover uranium from the Anaconda Yerington copper leach liquors. The necessary interfacing between the copper plant and the uranium plant is provided for and processing of the uranium is carried through to include drying, calcining and packaging of the yellowcake.

B. Alternate 1

In this alternate, the base case is modified to reflect processing the uranium to and including, solvent extraction at Yerington; and shipment of the high-grade strip solution to Bingham Canyon, Utah, for completion of the processing in the proposed uranium treatment plant at that

location. The required capital additions at the Bingham Canyon plant have been included in this estimate.

C. Alternate 2

In this alternate, the base case is modified to reflect processing the uranium to, and including, thickening of the precipitated uranium. The thickened slurry is shipped from Yerington to Bingham Canyon for centrifuging, drying, calcining and packaging. Any required capital additions at the Bingham Canyon plant have been provided for in this estimate.

D. Alternate 3

In this alternate, the base case is modified to reflect processing the uranium at Yerington to, and including, centrifuging of the yellowcake. The dewatered cake is shipped to Bingham Canyon for drying, calcining and packaging.

The preliminary capital cost details of the base case and alternates appear in the Appendix of this report. Budget prices were obtained from suppliers of major equipment, and appropriate factors were applied to determine the total cost of the constructed facilities. A contingency of 10% is included. Escalation, owner's costs and destination tax on equipment are not included. For purposes of this report, these exclusions are not expected to effect the comparisons.

The additional capital costs which would be required at Bingham Canyon for the various alternates were received from Mr. Ed Rousses of Jacobs Engineering, and are included as total costs.

## PRELIMINARY CAPITAL COST SUMMARY

| | COST - $ | | | |
|---|---|---|---|---|
| | Base Case | Alternate 1 | Alternate 2 | Alternate 3 |
| Building | 95,000 | 95,000 | 95,000 | 95,000 |
| Installed Equipment | 899,000 | 831,000 | 839,000 | 868,000 |
| Total Direct Cost | 994,000 | 926,000 | 934,000 | 963,000 |
| Engineering, Procurement and Construction Management | 149,000 | 139,000 | 140,000 | 144,000 |
| Contingency | 114,000 | 106,000 | 107,000 | 111,000 |
| Total Yerington Capital Cost | 1,257,000 | 1,171,000 | 1,181,000 | 1,218,000 |
| Total Bingham Canyon Capital Cost | | 26,000 | 10,000 | 10,000 |
| TOTAL CAPITAL COST | 1,257,000 | 1,197,000 | 1,191,000 | 1,228,000 |



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## 3. SUMMARY OF PRELIMINARY OPERATING COSTS

In the summary table of preliminary operating costs, the base case and alternates coincide with those outlined in the preliminary capital cost summary.

The operating costs in the base case were developed in the normal manner, and these costs were adjusted in the alternates to reflect any increase or shift in operating costs from Yerington to Bingham Canyon.

At the request of Dr. James Brooke of Wyoming Mineral Corporation, administrative costs have not been included in this estimate. The costs in this category would include supervision, technical support, payroll, insurance, taxes, etc.

In connection with insurance, it might be pointed out that it is likely that product liability and physical damage-type insurance policies will be required to cover the movement of high-value products from plant to plant.

The labor rates used were agreed to after discussions with Dr. Brooke and Mr. Mark Nesbitt of the Anaconda Yerington operation.

For purposes of this comparative exercise, the cost of supplies, as determined in the base case, was assumed to be the same whether these supplies were consumed in Yerington or in Bingham Canyon.

The number of operators required in the base case and alternates 2 and 3 has been estimated at a total of five. It is felt at this time that the work load would be too heavy for one operator to look after the complete plant. The

extra operator required would only be used during day-shift for five shifts per week.

The preliminary operating cost details of the base case and alternates appear in the Appendix of this report.

## PRELIMINARY OPERATING COST SUMMARY

ANNUAL COST - $

| | Base Case | Alternate 1 | Alternate 2 | Alternate 3 |
|---|---|---|---|---|
| Operating Labor | 115,336 | 96,936 | 115,336 | 115,336 |
| Operating Supplies | 161,982 | 154,991 | 158,812 | 160,108 |
| Total Maintenance | 36,000 | 33,200 | 33,600 | 34,700 |
| Other* | 6,011 | 13,623 | 9,479 | 6,543 |
| Total Yerington Operating Cost | 319,329 | 298,750 | 317,227 | 316,687 |
| Total Bingham Canyon Operating Cost | | 10,183 | 15,881 | 17,758 |
| TOTAL OPERATING COST | 319,329 | 308,933 | 333,108 | 334,445 |
| $/lb $U_3O_8$ | 6.374 | 6.166 | 6.649 | 6.676 |

*Includes freight and miscellaneous power costs.



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4. OBSERVATIONS

A. As discussed with Dr. Brooke, in the Wyoming Mineral preliminary economic analysis of the base case and various alternates, as outlined in the report, a cost item of considerable magnitude must be taken into account. Product liability and physical damage insurance costs will apply twice in each of the alternates examined.

These costs are considered owner's, or overhead, costs, and as such, are not included in this operating cost estimate.

B. An analysis of operating costs shows that the bleed of 3N sulphuric acid to tailings from the ion exchange circuit amounts to approximately $105,000, or about 33% of the total operating costs. It is felt that every effort should be expended to permit all or part of this acid to be used in the copper leach circuit.

C. It is suggested that the amine solvent extraction system be investigated as an alternative to the EHPA-TOPO circuit. All of the sodium carbonate used in one stripping pass, and the sulphuric acid required to neutralize the carbonate, is lost. In the amine circuit, the only reagent required would be ammonia and total consumption, including precipitation, should be in the order of 0.4 to 0.5 pounds per pound of $U_3O_8$.

## 5. PROCESS DESCRIPTION

The proposed process involves recovery of dissolved uranium values from copper leach solutions at the Anaconda acid leach plant near Yerington, Nevada. The uranium recovery step in the process will take place immediately prior to cementation of copper values.

Clarified copper leach solution at a flow rate of 700 gallons per minute and containing approximately 0.019 grams per liter of $U_3O_8$ is pumped from an existing pumping station to a surge tank located in the uranium plant building. Provision is made to bypass this flow to the cementation circuit, if this should become necessary.

The first step in the uranium recovery process is treatment of the copper leach liquor in a continuous counter-current ion exchange system,in which loading of the resin with uranium and stripping of the uranium are carried out simultaneously in separate compartments of the same system. The barren solution is returned to the copper circuit for cementation, and the 3N $H_2SO_4$ elution, or stripping solution, containing approximately 0.20 grams per liter of $U_3O_8$ is discharged into a surge tank prior to the next treatment step.

The ion exchange uranium-bearing solution is further treated at 63 gallons per minute in three stages of solvent extraction mixer-settlers. The organic phase of this circuit is a solution made up of 0.2M Di (2 Ethylhexyl) Phosphoric Acid (EHPA) and 0.05M Tri-N-Butyl Phosphine Oxide (TOPO) in kerosene.

The exchange in the solvent extraction circuit further upgrades the uranium content in the organic to approximately four grams per liter $U_3O_8$. The flow of organic is 3.2 gallons per minute.

After one stage of mixer-settler water wash, the organic is further treated in three stages of mixer-settler units for stripping of the uranium from the organic phase. The solution used for stripping is a 1M solution of sodium carbonate.

The stripped organic is recycled for use in the extraction circuit. The strip solution, containing approximately 42 grams per liter of $U_3O_8$, overflows to the carbonate neutralization tank where sulphuric acid is added to neutralize the carbonate solution. Heat is also added to this tank to facilitate the removal of $CO_2$ gas.

After neutralization, the strip solution overflows into the precipitation tank where gaseous ammonia is added to precipitate the uranium. The precipitated uranium overflows the precipitation tank and is treated in a small thickener for concentration of the solid phase.

The thickener overflow is recycled to ion exchange feed, and the thickener underflow is pumped to a centrifuge feed surge tank with a capacity of three days production. This capacity is required to permit a centrifuging and drying schedule of eight hours per day for five days per week.

The precipitated uranium is dewatered using a 6" x 12" solid bowl centrifuge. The centrifuge effluent is returned to the thickener, and the cake is dried and calcined in a Wysmont Model J, vertical, continuous tray dryer. The dryer discharges into a 55-gallon-capacity drum prior to shipment to the uranium refinery.

The off-gases from the dryer are treated by wet scrubbing to remove the last traces of yellowcake, and are discharged to the atmosphere. The scrub water is recycled with thickener overflow to ion exchange feed.

## 6. GENERAL CRITERIA

The information used to establish the preliminary design criteria was generally obtained from Wyoming Mineral personnel. In cases where information was not available, experience factors typical of other uranium plants were used to establish the criteria.

The general criteria, as included, was used in the development of the preliminary flow sheet and flow balance, preliminary sizing of equipment and calculation of reagent consumptions.

## GENERAL CRITERIA

### A. Production Data

| | |
|---|---|
| Feed Flow - GPM | = 700 |
| $U_3O_8$ Content - g/l | = 0.019 |
| $U_3O_8$ Content - lb/1000 gals | = 0.15855 |
| $U_3O_8$ Recovery | = 95% |
| Days/year | = 330 |
| Hours/day | = 24 |
| Annual $U_3O_8$ Production (lb) | = 50,103 |

### B. Ion Exchange

Loading

| | |
|---|---|
| $U_3O_8$ in Feed - g/l | = 0.019 |
| $U_3O_8$ in Barren - g/l | = 0.001 |

Elution

| | |
|---|---|
| Eluate Flow - GPM | = 63.2 |
| $U_3O_8$ in Eluate - g/l | = 0.20 |
| $H_2SO_4$ in Eluate - g/l | = 147 |

### C. Solvent Extraction

Extraction

| | |
|---|---|
| Organic Flow - GPM | = 3.2 |
| Organic $U_3O_8$ Loading - g/l | = 4.0 |
| Organic: Aqueous Ratio | = 1.25:1 |
| Mixing Time - (min.) | = 5 |
| Settling Area - sq ft/GPM | = 1 |
| Organic Composition | |
| $D_2EHPA$ - Molarity | = 0.2 |
| TOPO - Molarity | = 0.05 |
| Carrier | = Kerosene |

Stripping

| | |
|---|---|
| Strip Flow - GPM | = 0.3 |
| Strip $U_3O_8$ Loading - g/l | = 42.0 |
| Organic: Aqueous Ratio | = 1.25:1 |
| Mixing Time - (min.) | = 5 |
| Settling Area - sq ft/GPM | = 1 |
| $Na_2CO_3$ in Strip - g/l | = 106 |

D. Precipitation

| | | |
|---|---|---|
| $H_2SO_4$ Required - lb/lb $U_3O_8$ | = | 2.33 |
| $NH_3$ Required - lb/lb $U_3O_8$ | = | 0.2 |

E. Thickening

| | | |
|---|---|---|
| Area Required - sq ft/lb/day | = | 0.07 |

F. Centrifuging and Drying

| | | |
|---|---|---|
| Maximum Product Temperature - $^oF$ | = | 800 |

Production Schedule

| | | |
|---|---|---|
| Hours/day | = | 8 |
| Days/week | = | 5 |

# A. CAPITAL COST DETAILS

# CAPITAL COST DETAILS - BASE CASE

| SUMMARY | COST - $ | |
|---|---|---|
| Building | | |
| Site Preparation Allowance | 5,000 | |
| 44,000 cu ft @ $0.075/cu ft | 90,000 | |
| Total Building | | 95,000 |
| Equipment | | |
| Laboratory Equipment Allowance | 50,000 | |
| Ion Exchange | 461,190 | |
| Solvent Extraction | 151,610 | |
| Precipitation and Thickening | 10,365 | |
| Centrifuging | 21,135 | |
| Drying and Packaging | 24,700 | |
| Subtotal | 719,000 | |
| Piping | 27,000 | |
| Electrical and Instrumentation | 60,000 | |
| Installation | 93,000 | |
| Total Equipment | | 899,000 |
| Total Direct Cost | | 994,000 |
| Engineering, Procurement and Construction Management | | 149,000 |
| Contingency | | 114,000 |
| TOTAL CAPITAL COST | | 1,257,000 |

# EQUIPMENT COSTS - BASE CASE

| AREA | DELIVERED COST - $ | |
|---|---|---|
| **Ion Exchange** | | |
| 1 - 9' dia. x 9' FRP I.X. Feed Tank | 2,340 | |
| 1 - 4" 316 S.S. Pump c/w 40 HP Motor | 5,410 | |
| 1 - 6' dia. x 6' FRP I.X. Tails Tank | 1,100 | |
| 1 - Chem-Seps Continuous Ion Exchange System c/w Resin Trap Tank, Regenerant Tank and Pump, Iron Scrub Tank and Pump, Resin and All Control Equipment | 450,000 | |
| 1 - 9' dia. x 9' FRP Hi-Grade Eluate Tank | 2,340 | |
| Total Ion Exchange Equipment Cost | | 461,190 |
| **Solvent Extraction** | | |
| 1 - 2" 316 S.S. Feed Pump c/w 2 HP Motor | 1,110 | |
| 3 - Mixer-Settler Units - FRP 27' x 6½' x 4' c/w 3-5 HP Mixers | 78,000 | |
| 4 - Mixer-Settler Units - FRP 6½' x 22" x 3½' c/w 4-0.5 HP Mixers | 26,000 | |
| 1 - 2" 316 S.S. Eluate Return Pump c/w 2 HP Motor | 1,100 | |
| 1 - Strip Feed Metering Pump c/w 0.25 HP Motor | 230 | |
| 1 - Strip Make-up Agitating Mechanism c/w 1 HP Motor | 1,010 | |
| 1 - 1" 316 S.S. Vert. Sump Pump c/w 2 HP Motor | 2,000 | |
| 1 - 2" 316 S.S. Portable Moyno Pump c/w 2 HP Motor | 1,800 | |
| 2 - 4' Ø x 5' FRP Strip Sol'n Tanks | 1,440 | |
| 1 - 8' Ø x 9' FRP Organic Tank | 2,250 | |
| 1 - Organic Tank Mixing Mechanism 316 S.S. c/w 1 HP Motor | 1,470 | |
| 1 - 1" Strip Transfer Pump c/w 0.5 HP Motor | 200 | |
| Initial Solvent Charge | 35,000 | |
| Total Solvent Extraction Equipment Cost | | 151,610 |

## EQUIPMENT COSTS - BASE CASE (Cont'd)

| AREA | | DELIVERED COST - $ |
|---|---|---|
| **Precipitation and Thickening** | | |
| 1 - 18" Ø x 24" 316 S.S. Electric Jacketed Neut. Tank c/w 0.25 HP Mixer | 1,700 | |
| 1 - 18" Ø x 24" 316 S.S. Precip. Tank c/w 0.25 HP Mixer | 900 | |
| 1 - Thick. U'Flow Metering Pump c/w 0.25 HP Motor | 135 | |
| 1 - 4' Ø x 6' Denver Y.C. Thickener c/w 0.5 HP Mechanism | 6,600 | |
| 1 - 3' Ø x 3' FRP Centrifuge Surge Tank c/w 1/3 HP Mixer | 1,030 | |
| Total Neutralization, Precipitation and Thickening Equipment Cost | | 10,365 |
| **Centrifuging** | | |
| 1 - Metering Centrifuge Feed Pump c/w Motor | 135 | |
| 1 - 6" x 12" Bird Solid Bowl 316 S.S. Centrifuge c/w 5 HP Motor and Drive | 21,000 | |
| Total Centrifuging Equipment Cost | | 21,135 |
| **Drying and Packaging** | | |
| 1 - Wysmont Model J Vertical Continuous Tray Dryer c/w Heating System and Controls | 21,000 | |
| 1 - 75 CFM Wet Scrubber c/w 1 HP Fan and Motor | 1,000 | |
| 1 - 500 - 1500 lb Weigh Scale | 2,700 | |
| Total Drying and Packaging Equipment Cost | | 24,700 |
| **Analytical Equipment** | | |
| Allowance | | 50,000 |
| TOTAL EQUIPMENT COST | | 719,000 |

## Initial Charge of Chemicals - to be Capitalized

The two items of any significance in capital costs are ion exchange resin and the initial charge of organic.

The initial charge of resin is included with the package price of the ion exchange equipment.

The cost of organic required for start-up is calculated as follows:

| | | | | |
|---|---|---|---|---|
| Extraction Circuit | 8,900 gals @ | $2.79/gal | = | $24,831 |
| Stripping Circuit | 600 gals @ | 2.79/gal | = | 1,674 |
| Organic Tank | 3,000 gals @ | 2.79/gal | = | 8,370 |
| Total Cost of Organic | | | = | $34,875 |
| | | | say | $35,000 |

# CAPITAL COST DETAILS - Alternate 1

| SUMMARY | COST - $ | |
|---|---|---|
| Building | | 95,000 |
| Equipment | | |
| Laboratory Equipment Allowance | 50,000 | |
| Ion Exchange | 461,190 | |
| Solvent Extraction | 160,350 | |
| Subtotal | 671,540 | |
| Piping | 25,460 | |
| Electrical and Instrumentation | 56,000 | |
| Installation | 78,000 | |
| Total Equipment | | 831,000 |
| Total Direct Cost | | 926,000 |
| Engineering, Procurement and Construction Management | | 139,000 |
| Contingency | | 106,000 |
| Yerington Total Capital Cost | | 1,171,000 |
| Bingham Canyon Additional Capital Cost | | 26,000 |
| TOTAL CAPITAL COST | | 1,197,000 |

## EQUIPMENT COSTS - Alternate 1

In Alternate 1, it is assumed that after solvent extraction, the high-grade strip solution will be shipped by tank truck to the Kennecott uranium plant in Bingham Canyon, Utah, for further treatment. There are adjustments required in the capital to be expended at Yerington, as well as incremental increases in capital requirements at Bingham, to complete the processing.

For this alternative, Mr. Ed Rousses of Jacobs Engineering estimated additional capital at Bingham Canyon of $26,000.

| | |
|---|---|
| **Deletions at Yerington** | |
| Precipitation and Thickening | $10,365 |
| Centrifuging | 21,135 |
| Drying and Packaging | 24,700 |
| Total Deletions | $56,200 |
| **Additions at Yerington** | |
| 1 - Metering Pump c/w 0.25 HP Motor | $ 230 |
| 1 - 13' dia. x 15' FRP Tank | 7,500 |
| 1 - 2" 316 S.S. Truck Loading Pump c/w 2 HP Motor | 1,010 |
| Total Additions | $ 8,740 |

# CAPITAL COST DETAILS - Alternate 2

| SUMMARY | COST - $ | |
|---|---|---|
| Building | | 95,000 |
| Equipment | | |
| Laboratory Equipment Allowance | 50,000 | |
| Ion Exchange | 461,190 | |
| Solvent Extraction | 151,610 | |
| Precipitation, Thickening and Packaging | 15,200 | |
| Subtotal | 678,000 | |
| Piping | 26,000 | |
| Electrical and Instrumentation | 56,000 | |
| Installation | 79,000 | |
| Total Equipment | | 839,000 |
| Total Direct Cost | | 934,000 |
| Engineering, Procurement and Construction Management | | 140,000 |
| Contingency | | 107,000 |
| Yerington Total Capital Cost | | 1,181,000 |
| Bingham Canyon Additional Capital Cost | | 10,000 |
| TOTAL CAPITAL COST | | 1,191,000 |

# EQUIPMENT COSTS - Alternate 2

In Alternate 2, it is assumed that the plant at Yerington will process the uranium through to producing a 35% slurry of ammonium diuranate. This slurry will be shipped in 55-gallon drums to the Bingham Canyon plant for dewatering, drying and packaging.

Mr. Ed Rousses estimates that the additional capital required at Bingham Canyon will be $10,000.

| | |
|---|---|
| **Deletions at Yerington** | |
| 1 - Centrifuge c/w 5 HP Motor and Drive | $21,000 |
| 1 - Dryer c/w 5 HP Motor | 21,000 |
| 1 - Scrubber c/w 1 HP Motor | 1,000 |
| **Total Deletions** | $43,000 |
| | |
| **Additions at Yerington** | |
| 95 Drums @ $21/drum | $ 2,000 |
| **Total Additions** | $ 2,000 |

# CAPITAL COST DETAILS - Alternate 3

| SUMMARY | | COST - $ |
|---|---|---|
| Building | | 95,000 |
| Equipment | | |
| Laboratory Equipment Allowance | 50,000 | |
| Ion Exchange | 461,190 | |
| Solvent Extraction | 151,610 | |
| Precipitation and Thickening | 10,365 | |
| Centrifuging and Packaging | 24,835 | |
| Subtotal | 698,000 | |
| Piping | 26,000 | |
| Electrical and Instrumentation | 39,000 | |
| Installation | 78,000 | |
| Total Equipment | | 861,000 |
| Total Direct Cost | | 956,000 |
| Engineering, Procurement and Construction Management | | 144,000 |
| Contingency | | 111,000 |
| Yerington Total Capital Cost | | 1,211,000 |
| Bingham Canyon Additional Capital Cost | | 10,000 |
| TOTAL CAPITAL COST | | 1,221,000 |

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# EQUIPMENT COSTS - Alternate 3

In Alternate 3, it is assumed that the plant at Yerington will process the uranium through to centrifuging. The 50% solids yellowcake will be shipped in 55-gallon drums to Bingham Canyon for final processing.

The additional capital required at Bingham Canyon has been estimated at $10,000 by Mr. Ed Rousses.

| | |
|---|---|
| **Deletions at Yerington** | |
| 1 - Dryer c/w 5 HP Motor | $21,000 |
| 1 - Scrubber c/w 1 HP Motor | 1,000 |
| Total Deletions | $22,000 |
| **Additions at Yerington** | |
| 48 Drums @ $21/drum | $ 1,000 |
| Total Additions | $ 1,000 |

## B. OPERATING COST DETAILS

# OPERATING COSTS DETAILS - BASE CASE

| | Operating Labor | Operating Supplies | Total Maintenance | Other | Total |
|---|---|---|---|---|---|
| Ion Exchange | 115,336* | 129,203 | 36,000* | | 279,739 |
| Solvent Extraction | | 25,788 | | | 25,788 |
| Neutralization, Precipitation & Thickening | 3,821 | | | | 3,821 |
| Centrifuging, Drying & Packaging | 3,170 | | | | 3,170 |
| Freight | | | | 4,388 | 4,388 |
| Misc. Power | | | | 1,623 | 1,623 |
| TOTAL COST $/yr | 115,336 | 161,982 | 36,000 | 6,011 | 318,529 |
| $/lb $U_3O_8$ | 2.302 | 3.233 | 0.719 | 0.120 | 6.358 |

*Not distributed

# OPERATING COST DETAILS - BASE CASE

## Operating Labor

| No. | Rate | Cost/Year - $ |
|---|---|---|
| 1 Chemist | $1500/mo | 18,000 |
| 5 Operators | $6.80/hr | 70,720 |
| Subtotal | | 88,720 |
| Fringe Benefits @ 30% | | 26,616 |
| TOTAL OPERATING LABOR COST | | 115,336 |

Cost/lb $U_3O_8$ = $2.302

# OPERATING COST DETAILS - BASE CASE

| OPERATING SUPPLIES | ANNUAL COST - $ | |
|---|---|---|
| **Ion Exchange** | | |
| Resin - 150 cu ft @ $85.80/cu ft | 12,870 | |
| Sulphuric Acid - 3747 tons @ $28/ton | 104,916 | |
| Water - 6.7 x $10^6$ gals @ $0.025/1000 gals | 168 | |
| Power - 354,500 KWH @ $0.0275/KWH | 9,749 | |
| Analytical | 1,000 | |
| Miscellaneous | 500 | |
| Total Ion Exchange Operating Supplies | | 129,203 |
| Cost/lb $U_3O_8$ = $2.579 | | |
| **Solvent Extraction** | | |
| EHPA - 204 gals @ $16.04/gal | 3,272 | |
| TOPO - 65 gals @ $62.84/gal | 4,085 | |
| Kerosene - 2820 gals @ $0.45/gal | 1,269 | |
| Sodium Carbonate - 127,000 lb @ $0.082/lb | 10,414 | |
| Water - 328,000 gals @ $0.025/1000 gals | 8 | |
| Power - 190,543 KWH @ $0.0275/KWH | 5,240 | |
| Analytical | 1,000 | |
| Miscellaneous | 500 | |
| Total Solvent Extraction Operating Supplies | | 25,788 |
| Cost/lb $U_3O_8$ = $0.515 | | |
| **Neutralization, Precipitation & Thickening** | | |
| Sulphuric Acid - 60 tons @ $28/ton | 1,680 | |
| Ammonia - 10,021 lb @ $0.04/lb | 401 | |
| Power - 59,556 KWH @ $0.0275/KWH | 1,638 | |
| Water - 92,000 gals @ $0.025/1000 gals | 2 | |
| Miscellaneous | 100 | |
| Total Neutralization, Precipitation & Thickening Operating Supplies | | 3,821 |
| Cost/lb $U_3O_8$ = $0.076 | | |

APPENDIX C

36804.21

## OPERATING COST DETAILS - BASE CASE (Cont'd)

| OPERATING SUPPLIES | ANNUAL COST - $ | |
|---|---|---|
| **Centrifuging, Drying & Packaging** | | |
| Fuel Oil - 800 gals @ $0.34/gal | 272 | |
| Y.C. Drums - 67 @ $21 | 1,407 | |
| Water - 79,000 gals @ $0.025/1000 gals | 2 | |
| Power - 14,150 KWH @ $0.0275/KWH | 389 | |
| Analytical | 1,000 | |
| Miscellaneous | 100 | |
| Total Centrifuging, Drying & Packaging | | 3,170 |
| Cost/lb $U_3O_8$ - $0.063 | | |
| **Miscellaneous Power (lighting, etc.)** | | |
| 59,000 KWH @ $0.0275/KWH | 1,623 | |
| Total Miscellaneous Power | | 1,623 |
| Cost/lb $U_3O_8$ = $0.032 | | |
| TOTAL OPERATING SUPPLIES | | 163,605 |
| Cost/lb $U_3O_8$ = $3.265 | | |

# OPERATING COST DETAILS - BASE CASE

## REAGENT CONSUMPTIONS

### Ion Exchange

#### Sulphuric Acid

Iron Scrub - 0.15N = 7.35 g/l or 61.34 lb/1000 gals

Annual Requirements = $\frac{2.0 \times 330 \times 1440 \times 61.34}{1000}$ = 58,298 lb

Elution Acid - 3N = 147 g/l or 1226.7 lb/1000 gals

Annual Requirements = $\frac{12.5 \times 330 \times 1440 \times 1226.7}{1000}$ = 7,286,598 lb

Total 100% Acid = 7,344,896 lb

Total 98% Acid = 7,494,792 lb

#### Resin Replacement

Assume 25% replacement/yr

Annual Requirements = 600 x 0.25 = 150 cu ft

#### Water

For Iron Scrub Acid

Water = $\frac{58,298}{0.0735} - 58,298 = \frac{734,872}{8.337}$ = 88,146 gals

For Elution Acid

Water = $\frac{7,286,598}{0.1347} - 7,286,598 = \frac{46,808,413}{8.337}$ = 5,614,539 gals

Less Water in 98% Acid = 149,896 gals

Total Dilution Water = 5,552,789 gals

Backwash Water 2.4 x 1440 x 330 = 1,140,480 gals

TOTAL ION EXCHANGE WATER = 12.7 GPM = 6,693,269 gals

# OPERATING COST DETAILS - BASE CASE (Cont'd)

## REAGENT CONSUMPTIONS

### Solvent Extraction

#### Total Organic

Assume loss at 0.5 gals/1000 gals of solvent extraction bled aqueous

Annual loss = $\frac{13.0 \times 330 \times 1440 \times 0.5}{1000}$ = 3,089 gals

#### Sodium Carbonate

Strip Sol'n = 1M = 106 g/l or 0.885 lb/gal
Strip Sol'n Loading = 42 g/l or 0.35 lb/gal
Gals/year= $\frac{50,103}{0.35}$ = 143,151

Sodium Carbonate Required = 143,151 x 0.885 = 126,689 lb

#### Water

In Strip Sol'n = $\frac{126,689}{0.076} - 126,689 = \frac{1,540,272}{8.337}$ = 184,751 gals

Organic Wash = 0.3 x 330 x 1440 = 142,560 gals

TOTAL SOLVENT EXTRACTION WATER/YEAR = 327,311 gals

### Neutralization, Precipitation & Thickening

#### Sulphuric Acid 98% to Neutralize Carbonate

$126,689 \times \frac{98}{106} \times \frac{1}{0.98}$ = 119,518 lb

#### Water in Acid

$\frac{119,518}{0.1347} - 119,518 = \frac{767,772}{8.337}$ = 92,092 gals

#### Ammonia

At 0.2 lb/lb $U_3O_8$ = 50,103 x 0.2 = 10,021 lb

## OPERATING COST DETAILS - BASE CASE (Cont'd)

### REAGENT CONSUMPTIONS

#### Centrifuging and Drying

Dryer Fuel = 800 gals/yr

Water - Centrifuge = $0.2 \times 1440 \times 330 \times \frac{0.0285}{0.12}$ = 22,572 gals/yr

Scrubber = $0.5 \times 1440 \times 330 \times \frac{0.0285}{0.12}$ = 56,430 gals/yr

TOTAL WATER THIS AREA = 79,002 gals/yr

#### Y.C. Drums

Assume 750 lb/drum

No. of drums required = $\frac{50,103}{750}$ = 67

# OPERATING COST DETAILS - BASE CASE

## POWER REQUIREMENTS

| Item | Motors x HP | Operating HP | |
|---|---|---|---|
| **Ion Exchange** | | | |
| Subtotal | 60.0 | | 60.0 |
| **Solvent Extraction** | | | |
| Solvent Extraction Feed Pump | 2.0 | 2.0 | |
| Extraction Mixers | 3 x 5.0 | 15.0 | |
| Eluate Return Pump | 1 x 2.0 | 2.0 | |
| Organic Wash Mixer | 1 x 0.5 | 0.5 | |
| Strip Feed Pump | 1 x 0.25 | 0.25 | |
| Strip Mixers | 3 x 0.5 | 1.5 | |
| Organic Feed Pump | 1 x 0.5 | 0.5 | |
| Strip Transfer Pump | 1 x 0.5 | 0.5 | |
| Strip Make-up Mixer | 1 x 1.0 | 1.0 | |
| Organic Tank Mixer | 1 x 1.0 | 1.0 | |
| Sump Pump | 1 x 2.0 | 2.0 | |
| Portable Pump | 1 x 2.0 | 2.0 | |
| Subtotal | | | 28.25 |
| **Neutralization, Precipitation & Thickening** | | | |
| Tank Heater | 1 x 0.25 | 8.0 | |
| Neut. Tank Mixer | 1 x 0.25 | 0.5 | |
| Precip. Tank Mixer | 1 x 0.25 | 0.5 | |
| Thick. Mechanism | 1 x 0.5 | 0.5 | |
| Thick. U'Flow Pump | 1 x 0.25 | 0.25 | |
| Cent. Surge Tank | 1 x 0.33 | 0.33 | |
| Subtotal | | | 10.08 |
| **Centrifuging, Drying & Packaging** | | | |
| Centrifuge Feed Pump | 1 x 0.25 | 0.25 | |
| Centrifuge | 1 x 5.0 | 5.0 | |
| Dryer | 1 x 5.0 | 5.0 | |
| Scrubber | 1 x 1.0 | 1.0 | |
| Subtotal | | | 11.25 |
| **Miscellaneous Power** | | | |
| Subtotal | 10.0 | | 10.0 |
| TOTAL | | | 119.58 |

# OPERATING COST DETAILS - BASE CASE

## UMMARY OF OPERATING SUPPLIES

| | ANNUAL COST - $ |
|---|---|
| ulphuric Acid | 106,596 |
| mmonia | 401 |
| HPA | 3,272 |
| OPO | 4,085 |
| erosene | 1,269 |
| odium Carbonate | 10,414 |
| esin | 12,870 |
| ower | 18,639 |
| nalytical Supplies | 3,000 |
| uel Oil | 272 |
| rums | 1,407 |
| ater | 180 |
| iscellaneous Supplies | 1,200 |
| OTAL OPERATING SUPPLIES | 163,605 |

Cost/lb $U_3O_8$ = $3.265

# OPERATING COST DETAILS - BASE CASE

## TOTAL MAINTENANCE

### Labor and Supplies

It is estimated that maintenance, labor and supplies should be approximately four percent of the installed equipment cost.

Maintenance Cost = 899,000 x 0.04 = $36,000

Cost/lb $U_3O_8$ = $0.719

# OPERATING COST DETAILS - BASE CASE

## FREIGHT

Gross weight to ship = 54,000 lb/yr

Freight Rate = $8.11/100 lb

TOTAL COST = 54,100 x 0.0811 = $4,388/yr

A loading and unloading allowance is included in the above rate.

# OPERATING COSTS DETAILS - Alternate 1

| | Operating Labor | Operating Supplies | Total Maintenance | Other | Total |
|---|---|---|---|---|---|
| Ion Exchange | 96,936* | 129,203 | 33,200* | | 258,639 |
| Solvent Extraction | | 25,788 | | | 25,788 |
| Neutralization, Precipitation & Thickening | | | | | |
| Centrifuging, Drying & Packaging | | | | | |
| Freight | | | | 12,000 | 12,000 |
| Misc. Power | | | | 1,623 | 1,623 |
| Yerington Total | 96,936 | 154,991 | 33,200 | 13,623 | 298,050 |
| Bingham Canyon Total | | 6,991 | | 3,192 | 10,183 |
| TOTAL | 96,936 | 161,982 | 31,120 | 16,815 | 308,233 |
| $/lb $U_3O_8$ | 1.935 | 3.233 | 0.663 | 0.336 | 6.152 |

*Not distributed

## OPERATING COSTS DETAILS - Alternate 1

n this alternate, high-grade strip solution is shipped by tank ruck to Bingham Canyon for final processing. There will be no dditional labor charges at Bingham Canyon in this case (Ed ousses). One operator can be reduced from the base case so here will be a total of four operators plus one chemist to perate the plant.

### eletions at Yerington

| | |
|---|---|
| Operating Labor (one operator only) | $18,400 |
| Supplies | |
| Neut., Precip. & Thick. | 3,821 |
| Cent., Drying & Packaging | 3,170 |
| Maintenance @ 4% of Equipment Cost | 2,680 |
| Freight (yellowcake) | 4,388 |
| Total Deletions | $32,459 |

### dditions at Yerington

| | |
|---|---|
| Freight $1,000/mo | $12,000* |
| Total Additions | $12,000 |

### dditions at Bingham Canyon

| | |
|---|---|
| No additional operator labor required | |
| Supplies | $ 6,991 |
| Freight 54,100 lb @ $5.90/100 lbs | 3,192 |
| Total Additions | $10,183 |

Based on flat rate of $1,000/mo for exclusive use of tanker.

## OPERATING COSTS DETAILS - Alternate 2

| | Operating Labor | Operating Supplies | Total Maintenance | Other | Total |
|---|---|---|---|---|---|
| ı Exchange | 115,336* | 129,203 | 33,600* | | 277,339 |
| lvent xtraction | | 25,788 | | | 25,788 |
| ıtralızatıon, recipıtatıon Thickenıng | | 3,821 | | | 3,821 |
| ntrifugıng, ryıng & ackagıng | | | | | |
| eıght | | | | 7,856 | 7,856 |
| sc. Power | | | | 1,623 | 1,623 |
| rington otal | 115,336 | 158,812 | 33,600 | 9,479 | 316,427 |
| ngham Canyon 'otal | 9,519 | 3,170 | | 3,192 | 15,881 |
| )TAL COST 'yr | 124,855 | 161,982 | 33,600 | 12,671 | 332,308 |
| '1b $U_3O_8$ | 2.492 | 3.233 | 0.671 | 0.253 | 6.632 |

Not distributed

# OPERATING COSTS DETAILS - Alternate 2

In this alternate, the processing has progressed up to and includes thickening of the precipitated yellowcake. The five operators will be required in this case, plus the chemist.

The thickened slurry will be barreled in 55-gallon drums and shipped to Bingham Canyon for final processing. Ed Rousses estimates that additional operating labor of three hours per day will be required for additional handling and accounting.

| | |
|---|---|
| **Deletions at Yerington** | |
| Supplies | |
| Centrifuging, Drying & Packaging | $ 3,170 |
| Maintenance | 2,320 |
| Freight (yellowcake) | 4,388 |
| Total Deletions | $ 9,878 |
| **Additions at Yerington** | |
| Freight 160,000 lb @ $4.91/100 lb | $ 7,856 |
| Total Additions | $ 7,856 |
| **Additions at Bingham Canyon** | |
| Labor $330 \times 3 \times \frac{20,000}{2,080}$ | $ 9,519 |
| Supplies | 3,170 |
| Freight 54,100 lb @ $5.90/100 lb | 3,192 |
| Total Additions | $15,881 |

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## OPERATING COSTS DETAILS - Alternate 3

| | Operating Labor | Operating Supplies | Total Maintenance | Other | Total |
|---|---|---|---|---|---|
| Ion Exchange | 115,336* | 129,203 | 34,700* | | 278,539 |
| Solvent Extraction | | 25,788 | | | 25,788 |
| Neutralization, Precipitation & Thickening | | 3,821 | | | 3,821 |
| Centrifuging, Drying & Packaging | | 1,296 | | | 1,296 |
| Freight | | | | 4,920 | 4,920 |
| Misc. Power | | | | 1,623 | 1,623 |
| Yerington Total | 115,336 | 160,108 | 34,700 | 6,543 | 315,987 |
| Bingham Canyon Total | 12,692 | 1,874 | | 3,192 | 17,758 |
| TOTAL COST $/yr | 128,028 | 161,982 | 34,700 | 9,735 | 333,745 |
| $/lb $U_3O_8$ | 2.555 | 3.233 | 0.693 | 0.194 | 6.662 |

*Not distributed

## OPERATING COSTS DETAILS - Alternate 3

n this alternate, processing at Yerington terminates after entrifuging of the yellowcake. The dewatered cake is ackaged in 55-gallon drums and shipped to Bingham Canyon for inal processing.

dditional labor costs at Bingham Canyon have been estimated by r. Ed Rousses at four hours per day.

### eletions at Yerington

| | |
|---|---|
| Supplies | |
| Fuel Oil | $ 272 |
| Drums | 1,407 |
| Power | 195 |
| Maintenance | 1,160 |
| Freight (yellowcake) | 4,388 |
| Total Deletions | $ 7,422 |

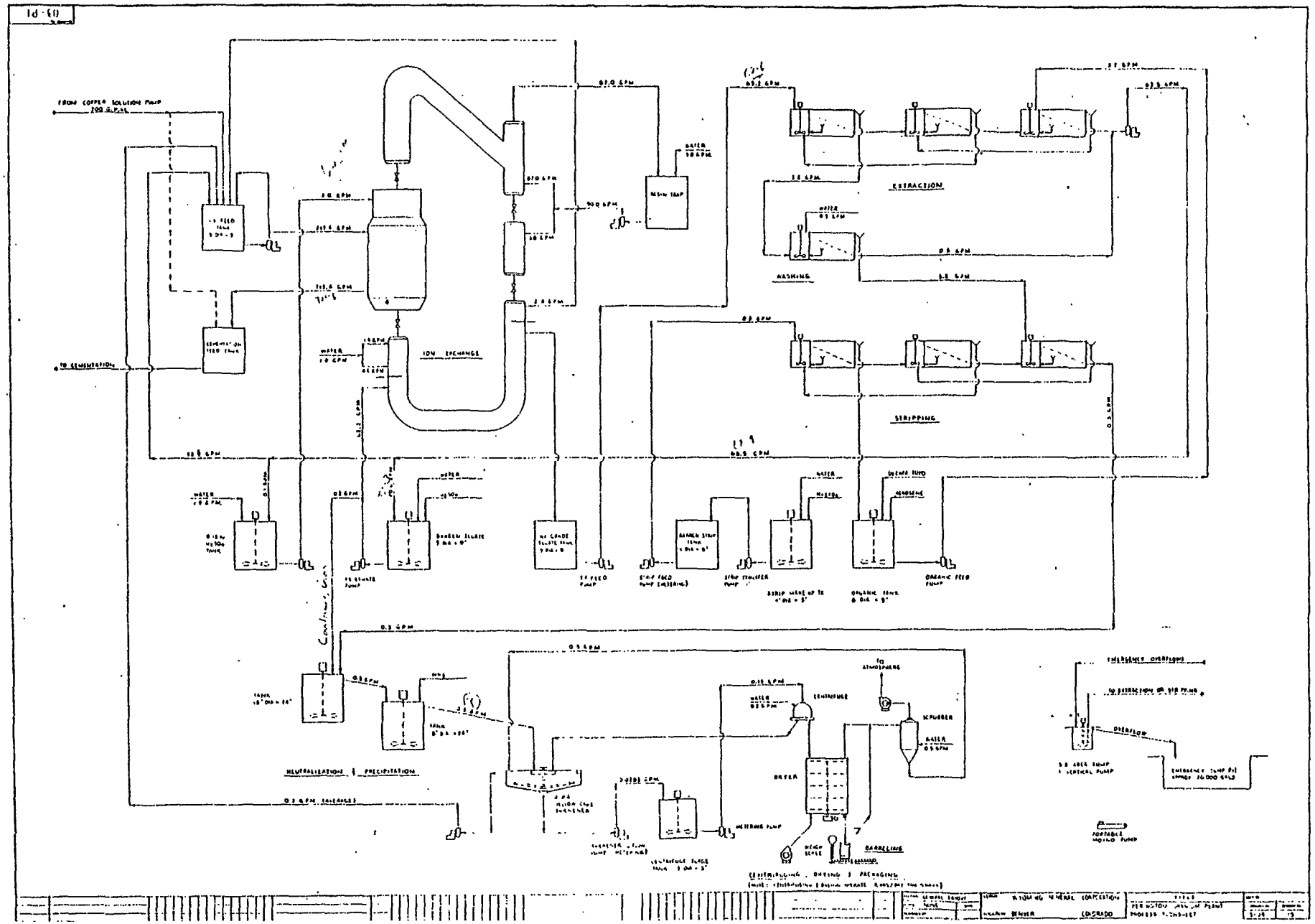
### dditions at Yerington

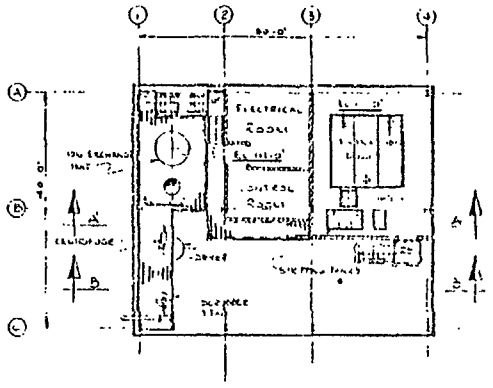
| | |
|---|---|
| Freight 100,206 @ $4.91/100 lb | $ 4,920 |
| Total Additions | $ 4,920 |

### Additions at Bingham Canyon

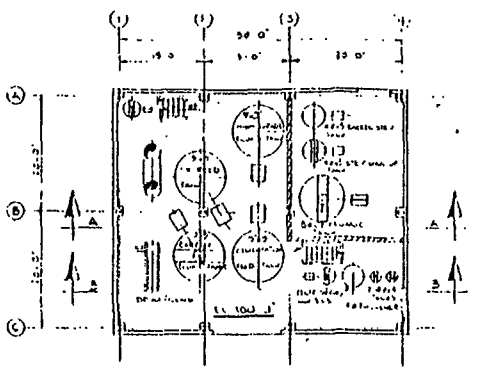
| | |
|---|---|
| Labor 330 x 4 x $\frac{20,000}{2,080}$ | $12,692 |
| Supplies | 1,874 |
| Freight 54,100 lb @ $5.90/100 lb | 3,192 |
| Total Additions | $17,758 |

## C. FLOW SHEET

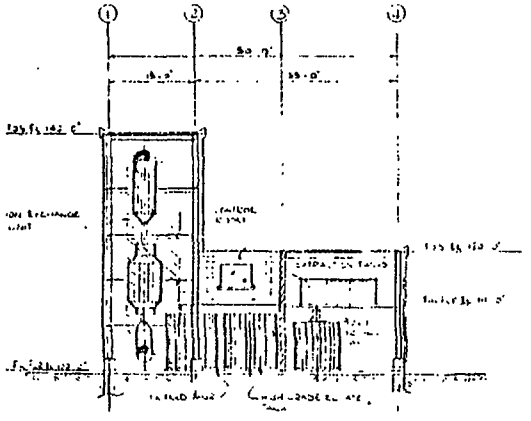




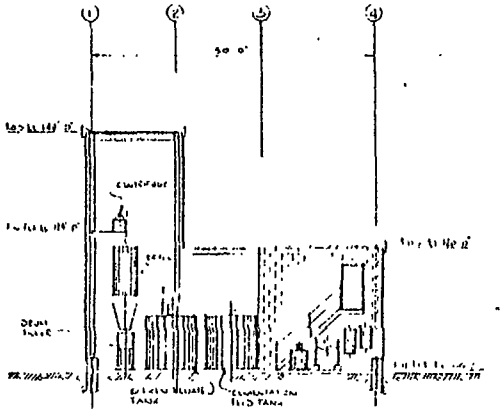
UPPER FLOORS PLAN



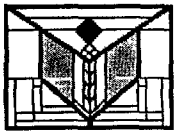
GROUND FLOOR PLAN



SECTION A-A



SECTION B-B



**James Sickles**

08/22/2003 03:38 PM

To: agravens@govmail.state.nv.us
cc: Arthur.Bonnie@epa.gov
cc:
Subject: Radiological Concerns and Comments on the Response to Comments for the Process Area Components Work Plan

Hi Art:

Catching up on some overdue e-mails. I talked with Carla and Gab earlier this week and they relayed some of the discussion you had on the radiological issues arising as a result of the documentation they retrieved from the Anaconda Archives and their request for an extension on the comments on the Response to Comments on the Process Area Components Work Plan, along with other items.

I agree with their concern and yours that we will need to be proactive on the radiological issues that come out of the documents. The numbers that are reported for uranium values are not huge but they were enough that Anaconda was looking at the economic feasibility of recovering the uranium. That may indicate that we may not have huge amount of uranium around but it does mean that we will have to do alot of work to ensure that we know what is there and what sort of risk we are looking at. Risk communication to the community in this sort of situation is critical as well. I have already seen and heard of concerns from the Walker River and Yerington Paiute Tribes, I would imagine that the other folks on the Yerington Technical Work Group are also concerned and wondering what it all means. I understand that NDEP is willing to consider leading the effort to look into the immediate concerns using an approach similar to that used to address the removal of the acids, etc, from the Arimetco areas. That would be good, and would show to the community everyone,s willingness to move ahead rapidly. I have been talking with our radiation folks, our risk assessor and community involvement coordinator about what everyone thinks is prudent, and we will let you know soon.

Currently it seems to make the best sense to (1) confirm the sampling reported in the old documents; (2) screen and sample those areas of contamination that could have current exposure, such as fugitive dust, groundwater, soils, etc. and (3) work on a comprehensive investigation for radiological contamination that could address the problem in an integrated, coordinated manner. It is our guess that this comprehensive investigation should be a separate work plan that could be added to the SOW. The problems created by the technical complexity of radiological contamination and it's fate and transport,, exacerbated by it's likely pervasive presence both on site and off, in conjunction with the community concern we feel supports such an approach. I realize that the details to be included in such an investigation are critical but will need to be addressed.

Finally like BLM we will need some more time to complete our comments on the Response to Comments. As I understand it they were suggesting an extension until Sept 4th. That sounds appropriate for us as well.

Talk with you soon. Take care.

Jim